

POLYOLEFIN-BASED ELASTIC CONJUGATED FIBER

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Abstract

PURPOSE: To provide the subject polyolefin-based elastic conjugated fiber free from stickiness, excellent in handleability in after processes and having improved heat resistance and alkali resistance.

CONSTITUTION: An elastic conjugated fiber characterized by its composition composed of the sheath consisting of one or more polymers selected from polyethylene, polypropylene, polystyrene and polybutene and the core consisting of a cross-linked polyurethane and its conjugation ratio of the crosssectional surface of the sheath/core fiber within a range of (3/1)-(99/1).

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POLYOLEFIN TYPE COMPOSITE ELASTIC FIBER

[Porioreflnkei fukugoh dan'seito]

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[There are no amendments to this patent.]

(54) [Title of the Invention]

Polyolefin type composite elastic fiber

(57) [Abstract]

[Purpose] The purpose of the present invention is to produce a polyolefin type composite elastic fiber having excellent handling ease during the course of post process without sticking, and improved heat-resistance and alkali resistance.

[Constitution] In a composite fiber where at least one polymer of a type selected from

among the group consisting of polyethylene, polypropylene, polystyrene and polybutene is used as the shell and the crosslinked polyurethane is used as the core, a composite elastic fiber characterized by the fact that the composite ratio at the horizontal cross-section of the core/shell is in the range of 3/1-99/1.

[Claims of the invention]

[Claim 1] A composite fiber wherein at least one type of polymer selected from the group consisting of polyethylene, polypropylene, polystyrene, and polybutene is used for the shell and a crosslinked polyurethane is used for the core, which composite elastic fiber is characterized by the fact that the composite ratio of the horizontal cross section of the core/shell is in the range of 3/1-99/1.

[Claim 2] The composite elastic fiber described in Claim 1 wherein the crosslinking is mainly based on a allophanate crosslinking structure.

[Detailed description of the invention]

[0001]

[Field of industrial application] The present invention pertains to a core-shell type composite elastic fiber where polyolefin is used for the shell and crosslinked polyurethane is used for the core.

[0002]

[Prior art] As a core-shell type composite fiber, urethane- urethane type elastomer fiber (for example, Japanese Kokoku [Examined] Patent Application No. Sho 61-14245

proposed by present inventors) and polyolefin-polyurethane type composite elastic fiber (for example, Japanese Kokoku [Examined] Patent Application No. Sho 61-194221 [1986]) are known as concentric type polyamide-urethane type elastomer fibers (for example, Japanese Kokoku [Examined] Patent Application No. Sho 55-27175 [1980] and Japanese Kokoku [Examined] Patent Application No. Hei 1-118619 [1989]) is known as eccentric type.

[0003]

[Problems to be solved by the invention] In urethane-urethane type composite fibers, urethane is used for the shell, thus, sticking unique to urethane poses a problem at the time of high-speed take-up, handling in post processes, and is disagreeable to the touch.

[0004] In the case of the composite elastic fiber where the shell is made of polyolefin, the heat-resistance is insufficient, and when the hardness of the urethane used as the core component is increased and the heat-resistance is increased, the recoverability of the composite fiber is reduced. Furthermore, the influence of the shell is high since the composite ratio of the core component and shell component is low, and the nature of the yarn is very poor. Thus, application of the material produced is limited mainly to adhesives.

[0005] Furthermore, in the case of a polyamide-urethane type composite fiber, stretchability is imparted for the first time when a crimping treatment is provided, and the yarn itself does not have stretchability. Furthermore, a stretching-relaxation treatment is required for production of the above-mentioned crimped yarn, and long

production time is required to produce a finished product.

[0006] Based on the above-mentioned background, the purpose of the present invention is to produce a new type of polyolefin composite elastic fiber in which the yarn itself exhibits stretchability and an absence of sticking and which has excellent handling ease during the course of post process.

[0007]

[Problems to be solved by the invention] As a result of much research carried out by the present inventors in an attempt to achieve the above-mentioned purpose, the present invention was accomplished. In other words, the present invention is a composite elastic fiber characterized by the fact that the composite ratio of the horizontal cross-section of the core/shell is in the range of 3/1~99/1 wherein at least one type of polymer selected from the group of polyethylene, polypropylene, polystyrene and polybutene is used for the shell and crosslinked polyurethane is used for the core.

[0008] In the following, the present invention is explained in further detail. As a shell component used in the present invention, at least a polymer selected from the group consisting of polyethylene, polystyrene, polypropylene, and polybutene is used.

Furthermore, dyes, and pigments such as titanium oxide, antioxidants, conductive agents, antibacterial agents, etc. can be added to the aforementioned polyolefin, as well.

[0009] The crosslinked polyurethane used as the core component that comprises the present invention, is a fiber-forming polyurethane where crosslinking is mainly done inside the molecules by means of the allophanate bonds. In the above-mentioned

method of production, polyisocyanate is added to molten thermoplastic polyurethane and mixing is provided, and allophanate crosslinking bonding is completed before spinning or after spinning, for example, the method described in Japanese Kokoku [Examined] Patent Application No. Sho 58-46573 [1983] and proposed by the present inventors, can be used. In this case, thermoplastic polyurethane means a hot-melt spinning polymer made of a polymer diol, diisocyanate, and chain extender:

[0010] For the polymer diol, ether type polyols having a hydroxyl group on both ends and molecular weight of 500~5,000 such as polytetramethylene glycol and polypropylene glycol, ester type polyols such as polyhexamethylene glycol, polybutylene adipate, polycarbonate diol, and polycaprolactone diol, and the above-mentioned glycols may be used independently or in the form of a mixture. For the chain extender, those with a molecular weight of 500 or below, for example, 1,4-butane diol, ethylene glycol, propylene glycol, bishydroxyethoxy benzene, etc. can be mentioned. For organic diisocyanate, tolylene diisocyanate (TDI), 4,4'-diphenyl methane diisocyanate (MDI), and non-yellowing diisocyanates, for example, 1,6-hexane diisocyanate, and mixtures thereof can be mentioned.

[0011] As for the hardness of the thermoplastic polyurethane, a range of 60~98 is desirable. When the hardness is 60 or below, the recoverability of the composite fiber produced is reduced, and spinning stability becomes inadequate, and other problems appear, thus, it is not desirable. On the other hand, when the hardness exceeds 98, the recoverability of the polyurethane itself becomes inadequate, and recoverability of the yarn cannot be expected unless crimping structure is used, and furthermore, the

range of applicable optimum spinning condition of the polyurethane is significantly reduced, thus, it is not desirable. For this reason, a range of 65~95 is desirable. Furthermore, dyes and pigments such as titanium oxide, antioxidants, conductive agents, antibacterial agents, and other additives commonly included in polyurethanes can be added to the aforementioned polyolefin, as well.

[0012] The polyisocyanate is a compound synthesized from a polyol component and an isocyanate component and containing at least 2, preferably, 2~3 isocyanate groups (NCO group) in the molecule. For the above-mentioned polyol component, in addition to the aforementioned diol having a molecular weight in a range of 500~4000 and used for synthesis of polyurethane a compound produced by mixing diol and triol and the functional group is adjusted to form a mean functional degree of 2~3, and furthermore, a synthetic polyol having a functional degree of 2~3 can be used effectively as well. For the above-mentioned isocyanate component, the aforementioned diisocyanate used for synthesis of polyurethane, a reaction product of trimer trimethylol propane of an organic diisocyanate and an organic diisocyanate, a monomer such as isocyanate (for example, isocyanate modified with carbodiimide), and mixture thereof can be used.

[0013] The reaction of the above-mentioned both components can be performed by a conventional method, and it is desirable when the reaction is performed in such a manner that an excess amount of isocyanate group (NCO group) is included, in other words, 2~15 wt% of the isocyanate group is included in the reaction product.

[0014] Furthermore, for the amount of the polyisocyanate added, in general, an amount of 5~40 wt% for the mixture of the thermoplastic polyurethane and the polyisocyanate

used for the core component is suitable. The amount added varies depending on the amount of the NCO group and the type of polyisocyanate used, and when the amount added exceeds 40%, mixing becomes inadequate and spinning becomes unstable and mechanical property of the yarn becomes inadequate. On the other hand, when the amount added is 5% or below, the heat-resistance of the yarn produced is sharply reduced, thus, an amount in a range of 10 to 30% is desirable.

[0015] In this manner, a crosslinking structure where the polyurethane with an allophanate crosslinking is the main component in the core component is produced. In this case, when the above-mentioned crosslinking structure is mainly based on the uret bond, the viscosity in the yarn is increased at the time of spinning of the yarn since the formation rate of the uret bond is faster than that of the allophanate bond, and stable spinning of the yarn cannot be achieved.

[0016] Components used for the core component and shell component are explained above, and the composite ratio of the core component and shell component is described below. The compound ratio of the core/shell component is preferably in a range of 3/1~99/1 in terms of the area ratio of the horizontal cross section of the yarn. When the ratio of the core/shell is 3/1 or below, the elastic recoverability of the yarn becomes inadequate, and recoverability and heat-resistance under high temperature become inadequate; on the other hand, when the above-mentioned ratio exceeds 99/1, rupturing of the shell component occurs or the core component is likely to be exposed on the surface of the yarn, and has an adverse effect of the spinning characteristics.

[0017] As for the composite state of the core-shell structure, it is desirable when the

center of gravity of both the core-shell components is the same from the standpoint of stability of spinning and uniformity of the yarn produced. Needless to say, a slight degree of eccentricity is tolerated in this case. Furthermore, the cross-section of the aforementioned composite fiber is not especially limited, and can be circular, triangle, etc.

[0018] In this case, the important factor is that the shell of the composite fiber completely covers the core and the center point of the shell and the core is about the same; thus, spinning can be done efficiently even when the balance in the viscosity of both components is slightly different. The above-mentioned property is absent in a yarn having an eccentric cross-section.

[0019] In the following, the manufacturing method of the present invention is described.

It is desirable when a hot-melt type composite fiber spinning device equipped with a spinning head having an area where polyisocyanate is added to the extruded molten thermoplastic polyurethane, an area where hot-melting of the shell component is carried out, and a core-shell composite spinneret.

[0020] For the device used for adding polyisocyanate during the course of spinning, a conventional device can be used in this case, as well. It is possible to use a kneader for adding and mixing of the polyisocyanate with a thermoplastic polyurethane under a molten state and it is desirable when a mixing device equipped with a stationary kneading element. For a mixing device equipped with a stationary kneading element, a conventional type can be used. The shape and the number of elements used for the

stationary kneading element vary depending on the condition used, and it is important for the thermoplastic polyurethane and polyisocyanate are thoroughly mixed before entering the composite spinneret, and in general, 20~90 elements are used.

[0021] Furthermore, when the mixing ratio X of the core/shell is increased to more than 15, upon designing the core-shell composite nozzle, the structure at the association member of the core component and shell component is formed in such a manner that (a) the guide groove of the shell component formed becomes 2.0 mm or below, (b) the distance between the lower member of the induction hole of the core component (inner orifice) and the upper member of the discharge hole of the core-shell composite flow (final orifice) is 0.05-1.0 mm.

[0022] When the polymer mixed as described above is used as the core component and the shell component polyol is made molten by a separate extruder and the above-mentioned two components are fed to a conventional core-shell composite spinneret, the composite fiber of the present invention can be produced.

[0023] Properties such as strength and heat-resistance are inferior in the composite fiber right after spun and take-up but a significant increase in the above-mentioned properties can be achieved when left standing at room temperature for approximately 2 hours to 7 days. It is hypothesized that the change in quality of yarn and the increase in heat-resistance with time are a result of the continuous reaction of the polyisocyanate mixed with the thermoplastic polyurethane as a spinning raw material that occurs even after spinning.

[0024]

[Effect of the invention] As described above, the yarn of the present invention has a polyolefin for the shell component and a crosslinked polyurethane for the core component; thus,

- Standard emulsion can be used as a lubricant at the time of spinning, and sticking hardly occurs.
- Excellent take-up can be achieved at the time of spinning, and so-called vertical take-up can be achieved.
- Superior post process can be made possible.
- High-speed take-up of 1000 m/min can be made possible after spinning, and take-up onto a bobbin or paper roll with a small diameter can be made possible as well.
- Hot-melt spinning method is used, thus, productivity is high and is suitable for industrial production.
- Fusion is absent even at a high temperature of 190°C.
- Alkali resistance is high.

[0025] Based on the above-mentioned superior properties, the material can be effectively used for a variety of applications such as swimsuits, socks, underwear, and panty hose.

[0026]

[Application Examples] In the following, the present invention is explained further in specific terms with application examples, but the present inventor is not limited to these examples.

[0027] Application Example 1

· Thermoplastic polyurethane

A polymerization reaction was carried out for 14.6 mole% of polyhexamethylene adipate with a molecular weight of 1,958, 50.5 mole% of p,p'-diphenylmethane diisocyanate and 34.9 mole% of 1,4-butane diol used as a chain extender as usual. The relative viscosity of the above-mentioned polymer measured in dimethyl formamide at 25°C at a concentration of 1 g/100 cc was 11.

[0028] · Polyisocyanate compound

A reaction was carried out for 23.9 mole% of polycaprolactone diol with a molecular weight of 1250 and functional degree of 2.0, 4.2 mole% of polycaprolactone triol with a molecular weight of 1250 and functional degree of 3, and 71.9 mole% of p,p'-diphenyl methane diisocyanate and production of a viscous compound was performed. The NCO wt% of the above-mentioned compound produced was 6.6 wt%.

[0029] · Polyethylene

As a shell component, a low-density polyethylene with a melting point of 100°C (PE356: product of Toso Co. (Ltd.)) was used.

[0030] Hot-melting was performed for the above-mentioned thermoplastic polyurethane by means of an extruder, the aforementioned polyisocyanate was added on the path of the above-mentioned hot-melt flow, and a thorough mixing was performed for the two components by a static mixer with 35 elements (product of Kenix [transliteration] Co., Ltd.), and meanwhile, hot-melting was performed for the above-mentioned polyethylene

by a separate extruder and measurement was performed separately for the both components, and then, guided toward the concentric 8 hole composite spinneret (nozzle diameter of 0.5 mm). The spinning speed of 600 m/min was used and production of a monofilament with a fiber diameter of 40d having a different core/shell composite ratio was produced.

[0030] Furthermore, spinning was carried out for the yarn without a polyisocyanate in the same manner (comparative example 2 [sic]). In this case, a 15% ester emulsion was used as a spinning lubricant. Meanwhile, spinning was performed with the above-mentioned thermoplastic polyurethane used as a shell component at a core-shell composite ratio of 12/1 in the same manner. In this case, a material mainly comprising dimethyl silicon was used as a lubricant (Comparative Example 2). And the results obtained are shown in Table I.

[0031]

[Table I]

	Application example 1	Application example 2	Application example 3	Comparative example 1	Comparative example 2
Core/shell composite ratio	4/1	12/1	40/1	2/1	12/1
Core component	Crosslinked polyurethane	←	←	←	Polyurethane
Shell component	Polyethylene	←	←	←	←
Strength (g/d)	1.81	1.79	1.72	1.11	0.93

Elongation (%)	486	469	504	522	513
Recoverability	63.6	74.4	89.1	23.1	63.2
190°C recovery	3	13	27	-13	Molten, and measurement not possible

[0032] In the above-mentioned table, the recoverability means the degree of recoverability when 100% stretching was done to two times at room temperature and the result is the value obtained based on the calculation below.

recoverability = [50% elongation stress upon second stretching] / [50% elongation stress at time of second restoration] x 100%

[0033] The 190°C recoverability is used for evaluation of the heat-resistance of the yarn and a composite fiber stretched to 30% at room temperature was treated in a 190°C hot air dryer for 1 minute and the recoverability measured upon restoring to room temperature and the calculation was made according to the equation shown below.

190°C recoverability = [length at the time of stretching - length after setting] / [length at the time of stretching - initial length] x 100 (%)

[0034] As shown in Table I, a significant change is observed in the heat-resistance depending on the presence of the crosslinking in the core component, in other words, when the core component is a crosslinked polyurethane, an excellent heat-resistance can be achieved, but when a polyurethane without crosslinking is used, a hot-melt resulted and measurement was not possible. Furthermore, when the composite ratio of the core/shell is 2/1, a sharp decrease in heat-resistance and recoverability is observed, and a product with very inferior properties is produced. With an increase in

the above-mentioned composite ratio, an increase in the heat-resistance and recoverability is observed. Furthermore, a heat-resistance greater than the melting point of the shell component can be achieved.

[0035] Application Example 2

The yarn of Application Example 2 and the yarn of Comparative Example 3 were used and an examination was made of the alkali resistance. For the alkali solution, a solution containing 10 wt% of sodium hydroxide was used, and a treatment was carried out at temperatures of 80[°C] and 100°C for 60 minutes, and the yarns were soaked in a free state and retention of strength was evaluated. And the results obtained are shown in Table II.

[0036]

[Table II]

Test No.		Yarn of Application Example 2	Yarn of Comparative Example 3
Temperature	80°C	105.8	63.2
	100°C	93.2	33.9

[0037] As shown in Table II, a significantly high alkali resistance can be obtained in the yarn of the present invention.

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